ORANGE PUBLIC SCHOOLS			
CONTENT AREA: Science/Chemistry	**GRADE: 9-12**	**UNIT #: 3**	**Chemical Reactions and Stoichiometry**

SCOPE AND SEQUENCE

OVERVIEW				
Lesson	Topic	PE's and DCI's	Chapter	Suggested Pacing (Blocks)
1	Chemical Reactions and Equations	HS-PS1-2 HS-PS 1-4 HS-PS1-7	5.3	8
2	Mathematics of formula and equations/ Stoichiometry	HS-PS1-2 HS-PS1-4 HS-PS1-6	5.4	9

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February 2017				
Mon	Tue	Wed	Thu	Fri
		1 Unit 3 pre test	2 Unit 3 pre test	3 Chemical reactions and Equations
6 Chemical reactions and Equations	7 Chemical reactions and Equations	8 Chemical reactions and Equations	9 Chemical reactions and Equations	10 Chemical reactions and Equations
13 Chemical reactions and Equations	14 Chemical reactions and Equations	15 Chemical reactions and Equations	16 Chemical reactions and Equations	17 Chemical reactions and Equations
20 Recess	21	22	23	24
27 Chemical reactions and Equations	28 Chemical reactions and Equations			

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March 2017				
Mon	Tue	Wed	Thu	Fri
		1 Chemical reactions and Equations	2 Stoichiometry	3 Stoichiometry
6 Stoichiometry	7 Stoichiometry	8 2:30 pm dismissal Stoichiometry	9 Stoichiometry	10 Stoichiometry
13 Stoichiometry	14 Stoichiometry	15 Stoichiometry	16 Stoichiometry	17 Stoichiometry
20 Stoichiometry	21 Stoichiometry	22 Stoichiometry	23 Stoichiometry	24 Stoichiometry
27 Stoichiometry	28 review	29 review	30 Unit 3 post test	31 Unit 3 post test

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- **What are five types of chemical reactions?**
- **How can you predict the products of each of the five types of chemical reactions?**
- **How can you represent chemical reactions using chemical equations?**
- **How molar mass is calculated and why is it useful?**
- **How are percent composition of a compound, empirical formula of a compound, and molecular formulas of a compound calculated?**
- **How are the principles of stoichiometry used to calculate quantities of reactants or products in a chemical reaction?**

Students will use a model to predict the relationships between systems or between components of a system. The periodic table is a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms. Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. Chemical processes and properties of materials underlie many important biological and geophysical phenomena. Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in total binding energy (i.e., the sum of all bond energies in the set of molecules) that are matched by changes in kinetic energy. In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present. Many substances react chemically with other substances to form new substances with different properties. This change in properties results from the ways in which atoms from the original substances are combined and rearranged in the new substances. However, the total number of each type of atom is conserved (does not change) in any chemical process, and thus mass does not change either. The property of conservation can be used, along with knowledge of the chemical properties of particular elements, to describe and predict the outcomes of reactions. Changes in matter in which the molecules do not change, but their positions and their motion relative to each other do change also occur (e.g., the forming of a solution)

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# Blocks	STUDENT LEARNING OBJECTIVES	CORRESPONDING PE's and DCIs	CURRICULAR & SUPPLEMENTAL RESOURCES	ASSESSMENT
11	**Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.** **Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.** **Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.** • Identify five types of chemical reactions. • Predict the products of a chemical reaction. • Write equations that represent chemical reactions.	**HS-PS 1-2** **HS-PS 1-4** **HS-PS 1-7**	Science tech Book/Chemistry: Discovery Education Chapter 5. session 3 Pre- test /unit 3 https://tools.discoveryeducation.com/assessment/viewAssessment.cfm?guidAssetID=78E3F14D-779D-473F-8C5A-48D3C4A16252&student= Activity 1: Exploration: Chemical reactions and equations. Activity 2: Modelling chemical reactions and Balancing them. Activity 3:Classifying Chemical reactions lab Activity 4: Lab on activity series	Common Assessment 1 (pre assessment) Exploration activity on chemical equations and reactions. Modeling Chemical reactions Design an inquiry lab. Teacher/students will design a rubric to assess the lab and lab writes up. Design an inquiry lab on activity series Teacher/students will design a rubric to assess the lab and lab writes up. Post Assessment

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# Blocks	STUDENT LEARNING OBJECTIVES	CORRESPONDING Pes and DCIs	CURRICULAR & SUPPLEMENTAL RESOURCES	ASSESSMENT
10	**Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.** **Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.** **Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.*** • Determine molar mass and formula mass. • Determine the percent composition of a compound. • Apply stoichiometric principles.	**HS-PS1-2** **HS-PS1-4** **HS-PS1-6**	Science tech Book/Chemistry: Discovery Education Chapter 5. session 4 Activity 5: exploring mathematics of formulas and equations. https://gtm-media.discoveryeducation.com/videos/DSC/data/Mathematics_of_Formulas_and_Equations_StudentWorksheet.pdf Activity 6: Exploring stoichiometry. https://www.explorelearning.com/index.cfm?method=cResource.dspView&ResourceID=515 Activity 7: Inquiry lab on reaction stoichiometry. https://gtm-media.discoveryeducation.com/videos/DSC/data/CHEM_MathFormEquat_TeacherHOL_FINAL.pdf Activity 7: hands on lab limiting reagent https://app.discoveryeducation.com/techbook/concept/conceptGUid/DE31CF62-2212-46ED-A925-20CD91D176B9/unitGuid/535F42EF-1EA8-4DB4-B7C3-67ED66107ACB#/tab=explore-tab&page=1&subTab=	Pre assessment Activity 5: Student Exploration formula and equation mathematics. Activity 6: Exploration activity Design an inquiry lab on reaction stoichiometry. Teacher/students will design a rubric to assess the lab and lab writes up. Design inquiry lab/hands on lab on limiting reagent. Teacher/students will design a rubric to assess the lab and lab writes up.

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The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models

Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.

- Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS1-4),(HS-PS1-8)
- Use a model to predict the relationships between systems or between components of a system. (HS-PS1-1)

Planning and Carrying Out Investigations

Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.

- Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-PS1-3)

Using Mathematics and Computational Thinking

Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Use mathematical representations of phenomena to support claims. (HS-PS1-7)

Disciplinary Core Ideas

PS1.A: Structure and Properties of Matter

- Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1)
- The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-1),(HS-PS1-2)
- The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HS-PS1-3),*(secondary to HS-PS2-6)*
- A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. (HS-PS1-4)

PS1.B: Chemical Reactions

- Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. (HS-PS1-4),(HS-PS1-5)
- In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present. (HS-PS1-6)
- The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. (HS-PS1-2),(HS-PS1-7)

PS1.C: Nuclear Processes

- Nuclear processes, including fusion, fission, and

Crosscutting Concepts

Patterns

- Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-1),(HS-PS1-2),(HS-PS1-3),(HS-PS1-5)

Energy and Matter

- In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. (HS-PS1-8)
- The total amount of energy and matter in closed systems is conserved. (HS-PS1-7)
- Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-PS1-4)

Stability and Change

- Much of science deals with constructing explanations of how things change and how they remain stable. (HS-PS1-6)

Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Science assumes the universe is a vast single system in which basic laws are consistent. (HS-PS1-7)

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Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. • Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. (HS-PS1-5) • Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-PS1-2) • Refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-PS1-6)	radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process. (HS-PS1-8) **PS2.B: Types of Interactions** • Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects.*(secondary to HS-PS1-1),(secondary to HS-PS1-3)* **ETS1.C: Optimizing the Design Solution** • Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. *(secondary to HS-PS1-6)*	

Connections to other DCIs in this grade-band:
HS.PS3.A (HS-PS1-4),(HS-PS1-5),(HS-PS1-8); **HS.PS3.B** (HS-PS1-4),(HS-PS1-6),(HS-PS1-7),(HS-PS1-8); **HS.PS3.C** (HS-PS1-8);**HS.PS3.D** (HS-PS1-4),(HS-PS1-8); **HS.LS1.C** (HS-PS1-1),(HS-PS1-2),(HS-PS1-4),(HS-PS1-7); **HS.LS2.B** (HS-PS1-7); **HS.ESS1.A** (HS-PS1-8); **HS.ESS1.C** (HS-PS1-8); **HS.ESS2.C** (HS-PS1-2),(HS-PS1-3)

Articulation of DCIs across grade-bands:
MS.PS1.A (HS-PS1-1),(HS-PS1-2),(HS-PS1-3),(HS-PS1-4),(HS-PS1-5),(HS-PS1-7),(HS-PS1-8); **MS.PS1.B** (HS-PS1-1),(HS-PS1-2),(HS-PS1-4),(HS-PS1-5),(HS-PS1-6),(HS-PS1-7),(HS-PS1-8); **MS.PS2.B** (HS-PS1-3),(HS-PS1-4),(HS-PS1-5); **MS.PS3.A** (HS-PS1-5); **MS.PS3.B**(HS-PS1-5); **MS.PS3.D** (HS-PS1-4); **MS.LS1.C** (HS-PS1-4),(HS-PS1-7); **MS.LS2.B** (HS-PS1-7); **MS.ESS2.A** (HS-PS1-7),(HS-PS1-8)

Common Core State Standards Connections:
ELA/Literacy -

RST.9-10.7	Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. *(HS-PS1-1)*
RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-PS1-3),(HS-PS1-5)
WHST.9-12.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-PS1-2),*(HS-PS1-5)*
WHST.9-12.5	Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and

	audience. (HS-PS1-2)
WHST.9-12.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-PS1-3),*(HS-PS1-6)*
WHST.11-12.8	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. (HS-PS1-3)
WHST.9-12.9	Draw evidence from informational texts to support analysis, reflection, and research. *(HS-PS1-3)*
SL.11-12.5	Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. *(HS-PS1-4)*
Mathematics -	
MP.2	Reason abstractly and quantitatively. (HS-PS1-5),(HS-PS1-7)
MP.4	Model with mathematics. *(HS-PS1-4),(HS-PS1-8)*
HSN-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-PS1-2),*(HS-PS1-3),(HS-PS1-4),(HS-PS1-5)*,(HS-PS1-7),(HS-PS1-8)
HSN-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling. (HS-PS1-4),*(HS-PS1-7)*,(HS-PS1-8)
HSN-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. *(HS-PS1-2),(HS-PS1-3),(HS-PS1-4),(HS-PS1-5),(HS-PS1-7),(HS-PS1-8)*

* The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

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Modifications
Teacher Note: Teachers identify the modifications that they will use in the unit. The unneeded modifications can then be deleted from the list. • Restructure lesson using UDL principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA) • Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community. • Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling). • Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). • Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences). • Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings. • Use project-based science learning to connect science with observable phenomena. • Structure the learning around explaining or solving a social or community-based issue. • Provide ELL students with multiple literacy strategies. • Collaborate with after-school programs or clubs to extend learning opportunities.

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Content Area: 21st Century Life and Careers

SCIENCE, TECHNOLOGY, ENGINEERING & MATHEMATICS CAREER CLUSTER®	
Number	Standard Statement
By the end of Grade 12, Career and Technical Education Program completers will be able to:	
PATHWAY	*SCIENCE & MATHEMATICS CAREER PATHWAY (ST-SM)*
9.3.ST-SM.1	Apply science and mathematics to provide results, answers and algorithms for engineering and technological activities.
9.3.ST-SM.2	Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems
9.3.ST-SM.3	Analyze the impact that science and mathematics has on society.
9.3.ST-SM.4	Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data